Table 1
Preliminary Total Nitrogen Loadings for Nueces Bay Nutrient Budget

Component and N Load (million grams TN/yr)	Description of Calculation	Sources
WWTPs[a]		**Pre-development flow** Pacheco, P.A., D.R.G. Farrow, T. Manuelides, S.O. Rohmann, M. Katz, and J. McLeod, 1990. *Point Source Discharges in Coastal Areas of Texas – A Summary by Estuarine Watershed for 1987. DRAFT*. May 1990. **PCS-ICIS database (DMR data)** USEPA, 2016. Envirofacts. Updated: March 28, 2016. Cited: December 21, 2016. Available from: https://www3.epa.gov/enviro/facts/pcs-icis/search.html
Pre-development 21	Flow: from 1987 for each WWTP (Allison and City of Portland; Pacheco 1990) Concentration: see Post-development	
Post-development 21	Flow: estimated from DMR data for Allison WWTP (1995 – 2013) and City of Portland WWTP (2002 – 2016) Concentration: average of DMR TN data for Allison WWTP (1995 – 2013; ~4 mg/L); assumed TN concentration for City of Portland WWTP effluent is same	
Gaged Streams		**TN Loads** HDR, 2015. *Nueces BBASC Work Plan Study No. 3: Nueces Watershed Pre-and Post-Development Nutrient Budgets*. Prepared for Texas Water Development Board. August 2015.
Pre-development 471	Pre-1986 load was provided at Three Rivers (Table 8-4 of HDR 2015), but not at Mathis. Assumed pre-1986 percent change in load between Three Rivers and Mathis stations is same as for post-1986 (Table 8-5 of HDR 2015). Applied this percent change to HDR-estimated post-1986 load at Three Rivers.	
Post-development 122	From Table 8-4 of HDR 2015	
Ungaged Watersheds[b]		**Runoff (TxRR model output)** Fernando, N., 2017. Regarding: Nueces Bay nutrient budget – request for ungaged flow estimates from TxRR model. Email to E. Chen. January 13, 2017. **Runoff TN concentration by land use type for CCBNEP Study area** Baird, C., M. Jennings, D. Ockerman, and T. Dybala, 1996. *Characterization of Nonpoint Sources and Loadings to Corpus Christi Bay National Estuary Program Study Area*. CCBNEP-05. January 1996. **Land use (2011 NLCD)** Homer, C.G., J.A. Dewitz, L. Yang, S. Jin, P. Danielson, G. Xian, J. Coulston, N.D. Herold, J.D. Wickham, and K. Megown, 2015. Completion of the 2011 National Land Cover Database for the conterminous United States-Representing a decade of land cover change information. *Photogrammetric Engineering and Remote Sensing* 81(5):345-354
Pre-development 90	Flow: average of TxRR flows from 1941 – 1986 Concentration: see Post-development	
Post-development 68	Flow: average of TxRR flows from 1987 – 2015 Concentration: land-use weighted concentrations for each watershed	
Wet Deposition Pre- and Post-development 27 **Dry Deposition** Pre- and Post-development 34	Initial value taken from 1998 results from Whites Point station on Nueces Bay. 1998 was most complete record for a given year. Applied same assumption used in the paper of 19% organic N composition of TN. Value was scaled to surface area of Nueces Bay.	**Deposition rates** Wade, T.L., and S.T. Sweet, 2008. *Final Report Coastal Bend Bays and Estuaries Program (CBBEP): Atmospheric Deposition Study*. Prepared for Coastal Bend Bays and Estuary Program. March 2008. **Assumption for scaling organic N to TN** Ockerman, D.J., and C.W. Livingston, 1999. *Nitrogen Concentrations and Deposition in Rainfall at Two Sites in the Coastal Bend Area, South Texas, 1996-1998*. USGS Fact Sheet FS-146-99. U.S. Geological Survey.
Nitrogen Fixation Pre- and Post-development 167	Average of rates from sites in Nueces Bay and Corpus Christi Bay because data from Nueces Bay alone was too limited. Value was scaled to surface area of Nueces Bay.	**N fixation rate** Gardner, W.S., M.J. McCarty, S. An, and D. Sobolev, 2006. Nitrogen Fixation and Dissimilatory Nitrate Reduction to Ammonium (DNRA) Support Nitrogen Dynamics in Texas Estuaries. *Limnology Oceanography* 51(1, part 2):558-568
Groundwater Discharge Pre- and Post-development 330[c]	Midpoint of range reported (180-480 × 10^6 g N/yr). The paper only reports N as NO_3, so this value assumes that NO_3 is main species of N in groundwater.	**NO_3 loading rate** Breier, J.A., H.N. Edmonds, and T.A. Villareal, 2004. *Submarine Groundwater Discharge and Associated Nutrient Fluxes to the Corpus Christi Bay System.* Report 2002483416, Texas Water Development Board, Austin, Texas.
Tidal Exchange Pre- and Post-development 324	Water entrainment rate: iteratively apply a salt-balance calculation adapted from Brock 1998[d] and compare results to TxBLEND-predicted salinity TN = average TKN + average NOx Average TKN was for 1974 – 2010. For Nueces Bay and Corpus Christi Bay, average NOx was for 1969 – 2010 and for 1968 – 2010, respectively. Load entering Nueces Bay = TN conc in Corpus Christi Bay × water entrainment rate × total volume of flood tide Load exiting Nueces Bay = TN conc in Nueces Bay × water entrainment rate × total volume of ebb tide	**TxBLEND model inputs and outputs** Fernando, N., 2017. Regarding: Nueces Bay nutrient budget – request for ungaged flow estimates from TxRR model. Email to E. Chen. April 11 and April 20, 2017. **Concentrations in Nueces and Corpus Christi Bays** Montagna, P.A., and T.A. Palmer, 2012. *Water and Sediment Quality Status and Trends in the Coastal Bend Phase 2: Data Analysis*. Prepared for Coastal Bend Bays and Estuaries Program. Project Number – 1206. August 2012.
Denitrification Pre- and Post-development -776	Average of measured values from two Nueces Bay stations. Because there were two more summer measurements compared to spring and fall, averaged summer values together before averaging with spring and fall values. Value was scaled to surface area of Nueces Bay.	**Denitrification rate** Yoon, W.B., and R. Benner, 1992. Denitrification and Oxygen Consumption in Sediments of Two South Texas Estuaries. *Marine Ecology Progress Series* 90:157-167
Nitrogen Burial Pre- and Post-development -106	Mean rates of deposition from Nueces Bay sites, mean sediment density, and TN content of sediment at 10 cm depth were used to calculate burial rate assuming an active depth of 10 cm. Value was scaled to surface area of Nueces Bay.	**Rate of deposition** Santschi, P., and K. Yeager, 2004. *Quantification of Terrestrial and Marine Sediment Sources to a Managed Fluvial, Deltaic and Estuarine System: The Nueces-Corpus Christi Estuary, Texas.* Final Report to the Texas Water Development Board, Contract #2003-483. **Sediment density** Hill, E.M., M. Besonen, P. Tissot, and B.A. Nicolau, 2014. *Nueces Bay Zinc Sediment Profiling Assessment.* Final Report to the Coastal Bend Bays & Estuaries Program. **TN content of sediment at 10 cm depth** Brock, D.A., 2001. Nitrogen Budget for Low and High Freshwater Inflows, Nueces Estuary, Texas. *Estuaries* (4):509–521

Notes:
a. City of Corpus Christi Allison WWTP and City of Portland WWTP
b. Watersheds #21010 (between Mathis and Calallen Dam), #22012 (between Calallen Dam and Nueces Bay), and 50% of #20005 (along northern shore of Nueces Bay)
c. The groundwater value is for N as NO_3. Total N flux may be higher.
d. Brock, D.A., 1998. Salinity Recovery in Texas Bays. *Texas J. Sci*. 50(1):17-34
CCBNEP: Corpus Christi Bay National Estuary Program
cm: centimeter
conc: concentration
DMR: Discharge Monitoring Report
g: gram
N: nitrogen
NADP: National Atmospheric Deposition Program
NLCD: National Land Cover Database
NO_3: nitrate
NOx: nitrate plus nitrite
SWQM: Surface Water Quality Monitoring
TAMUCC: Texas A&M University Corpus Christi
TCEQ: Texas Commission on Environmental Quality
TKN: total Kjeldahl nitrogen
TN: total nitrogen
USEPA: U.S. Environmental Protection Agency
WWTP: wastewater treatment plant
yr: year

Please direct questions and suggestions to:
Dan Opdyke, Anchor QEA
(512)306-3705
dopdyke@anchorqea.com